

# Ocean Observations and Ocean Research Status and A Vision for the Future

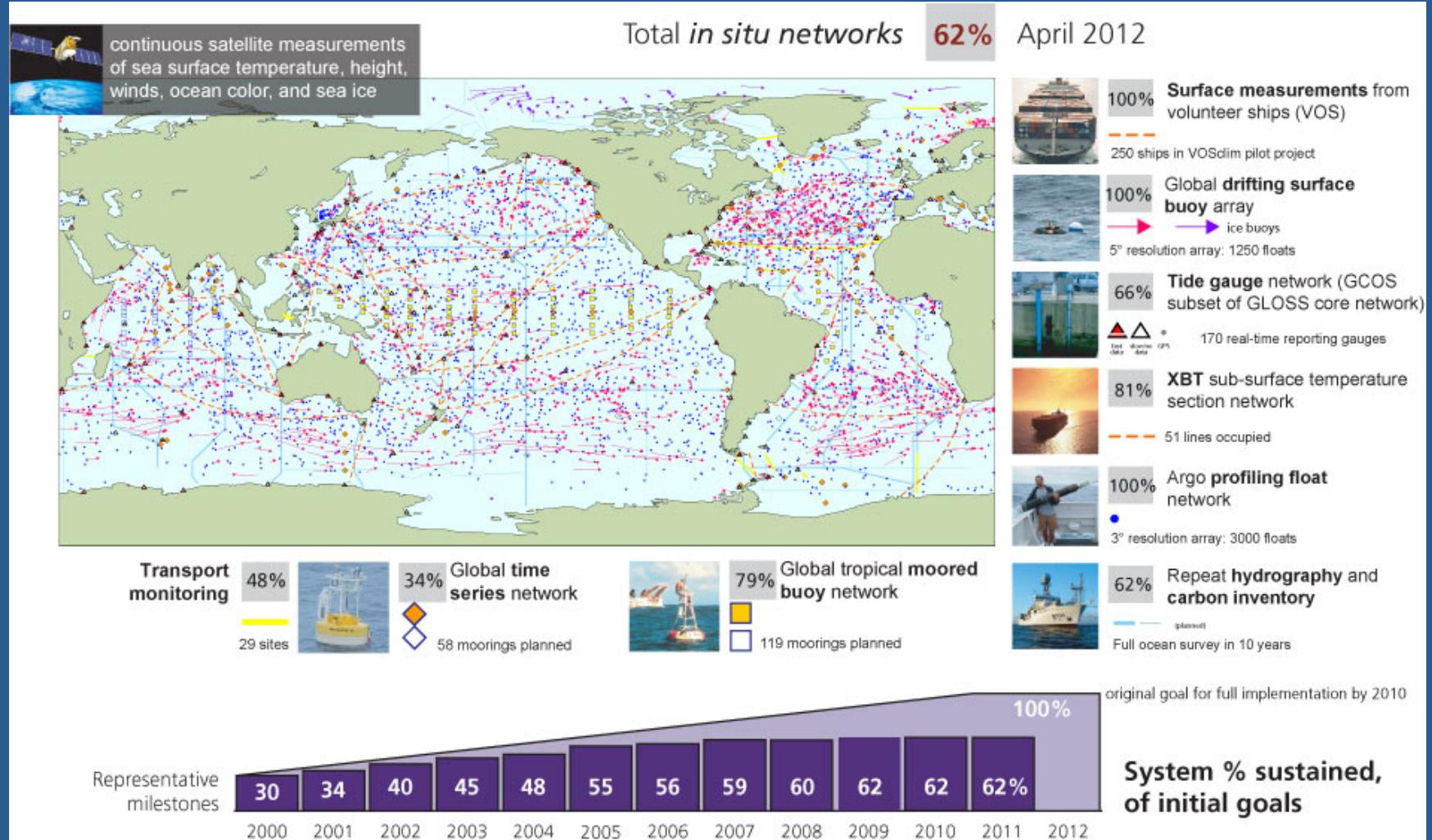
Rick Spinrad

Chair, U.S. IOOS Federal Advisory Committee

Vice President for Research, Oregon State University

RNC / December 2, 2012/ San Francisco, CA

# Ocean Obs and Data: National to Global



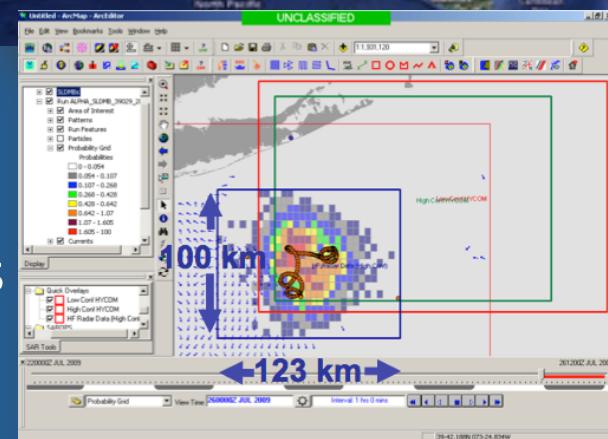
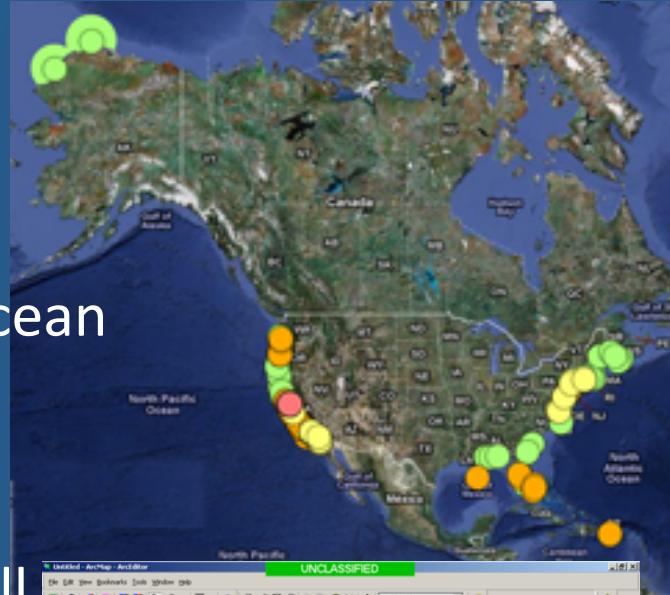
# HF Radar: Example of a National Observing Network

## Stakeholders

- > 30 institutions operate HF Radars;
- >40 government/private entities
- Industry Partner: US-based CODAR Ocean Sensor

## Who Depends on it

- Coast Guard : Search & Rescue: Oil spill
- Water quality; Criminal forensics
- Commercial marine navigation
- Offshore energy; Harmful algal blooms
- Marine fisheries
- Emerging – Tsunami



Decreases search area by 66% in 96 hours



# IOOS Works!



**IOOS mobilizes technologies to hasten response to oil spills and harmful algal blooms**



Improves the quality  
of life at home and  
around the globe

Surface current data, continuous and  
in near real time, inform models

People lost at sea are found faster

Pollution can be tracked and  
ecosystems better assessed

*U.S. Integrated Ocean Observing System (IOOS)*

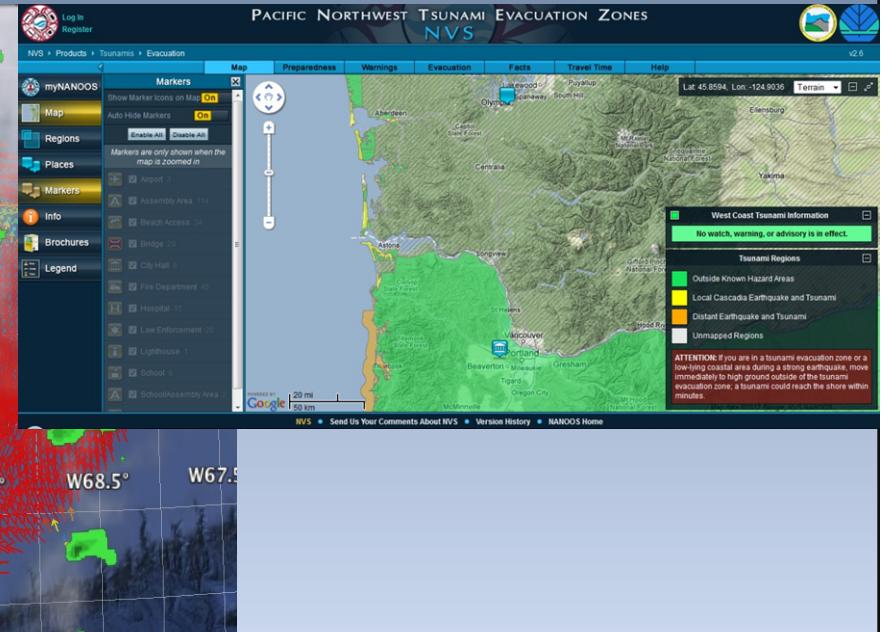
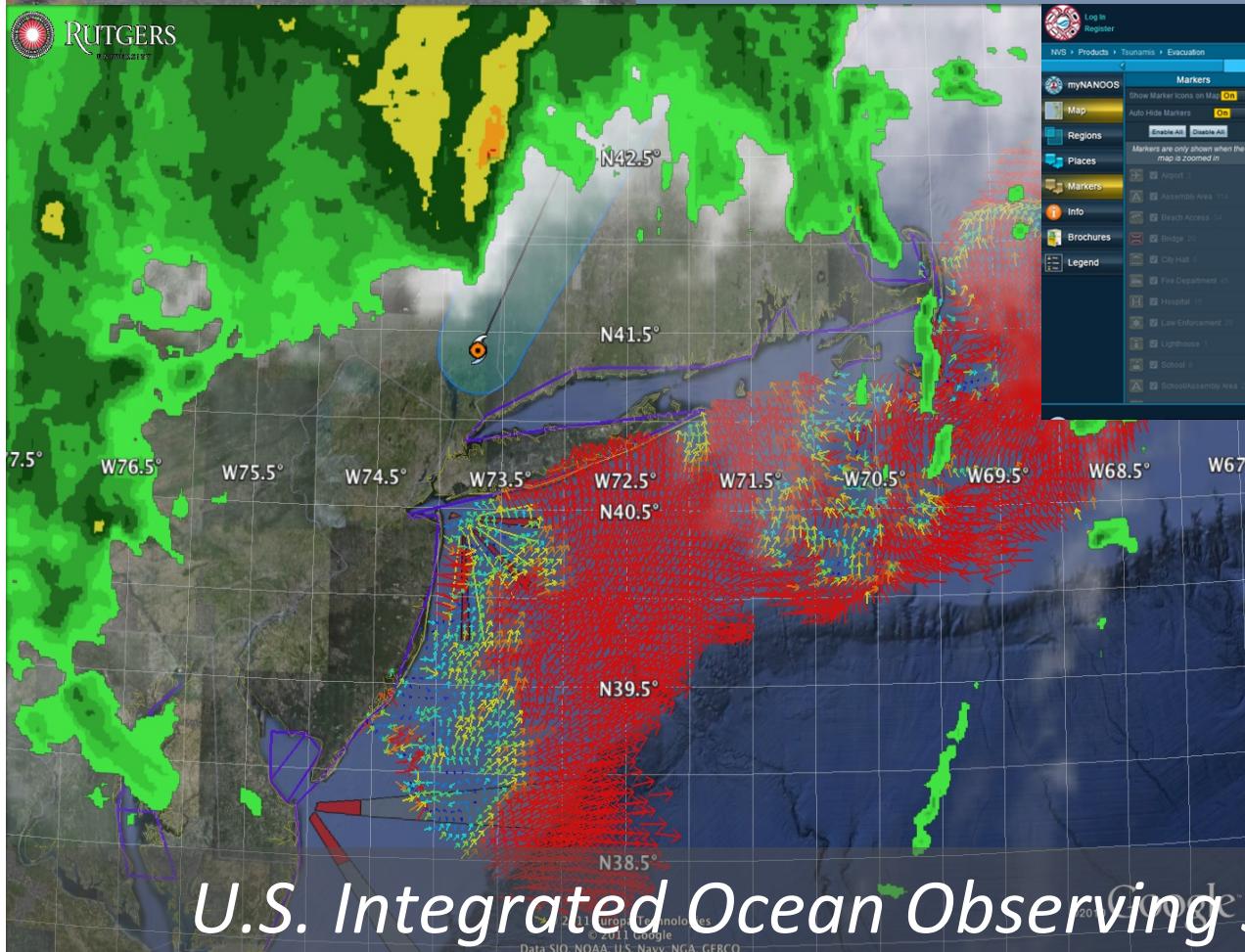


# IOOS Works!



Storm-driven flood predictions  
accurate to a city block

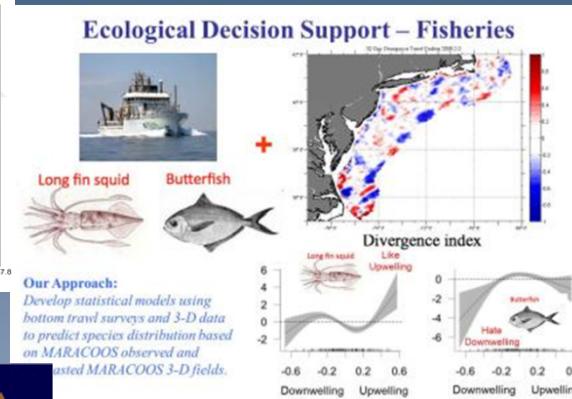
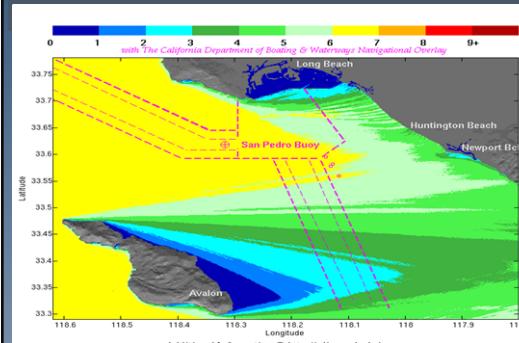
Tsunami evacuation zone  
details available online



Around-the-clock data and  
other information before,  
during and after hurricanes

*U.S. Integrated Ocean Observing System (IOOS)*

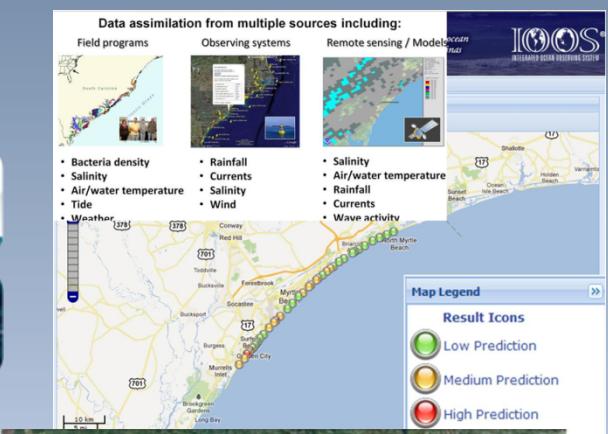
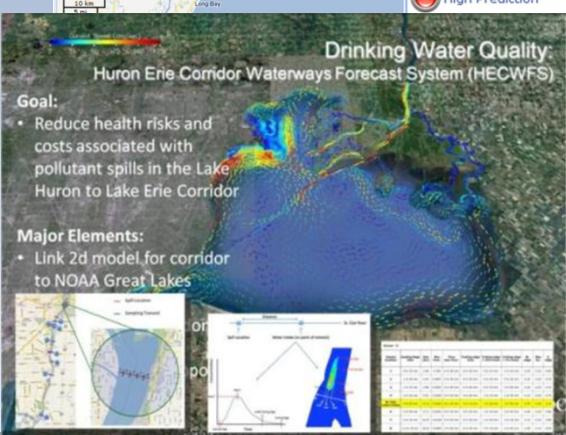
# IOOS Works!



**Our Approach:**  
Develop statistical models using bottom trawl surveys and 3-D data to predict species distribution based on MARACOOS observed and forecasted MARACOOS 3-D fields.



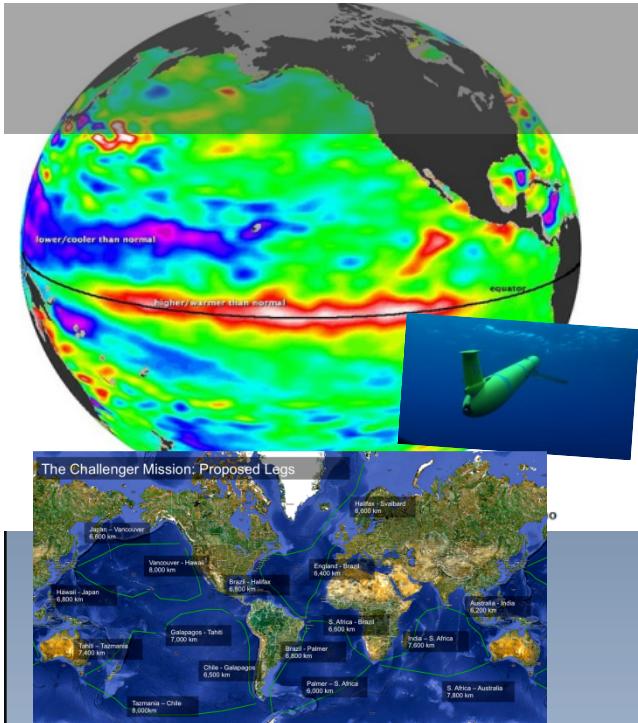
*U.S. Integrated Ocean Observing System (IOOS)*



**Weather Conditions - NWS WFO**  
marine desks “routinely integrate NERACOOS data into our forecasts and warning operations on an hourly basis”.  
Coastal Inundation tools and forecasts.  
Forecasting ship icing potential.

# IOOS Works!

U.S. IOOS partners sent the first glider across the Atlantic Ocean, calibrating ocean models and collaborating with scientists and students in the U.S., Canada, Spain and Portugal



Teaching the next generation



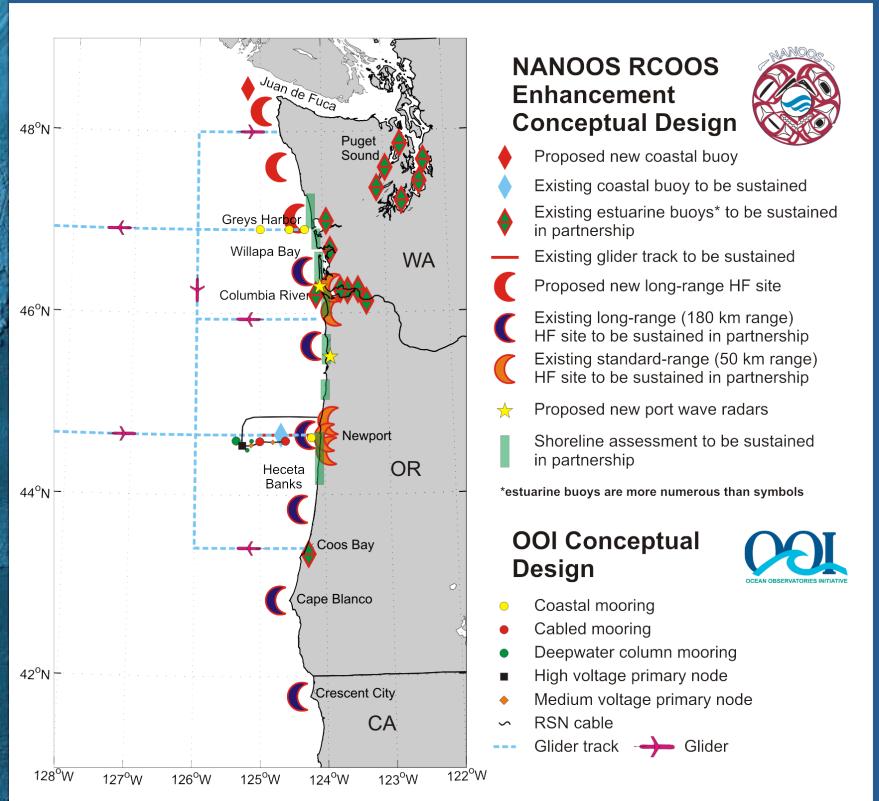
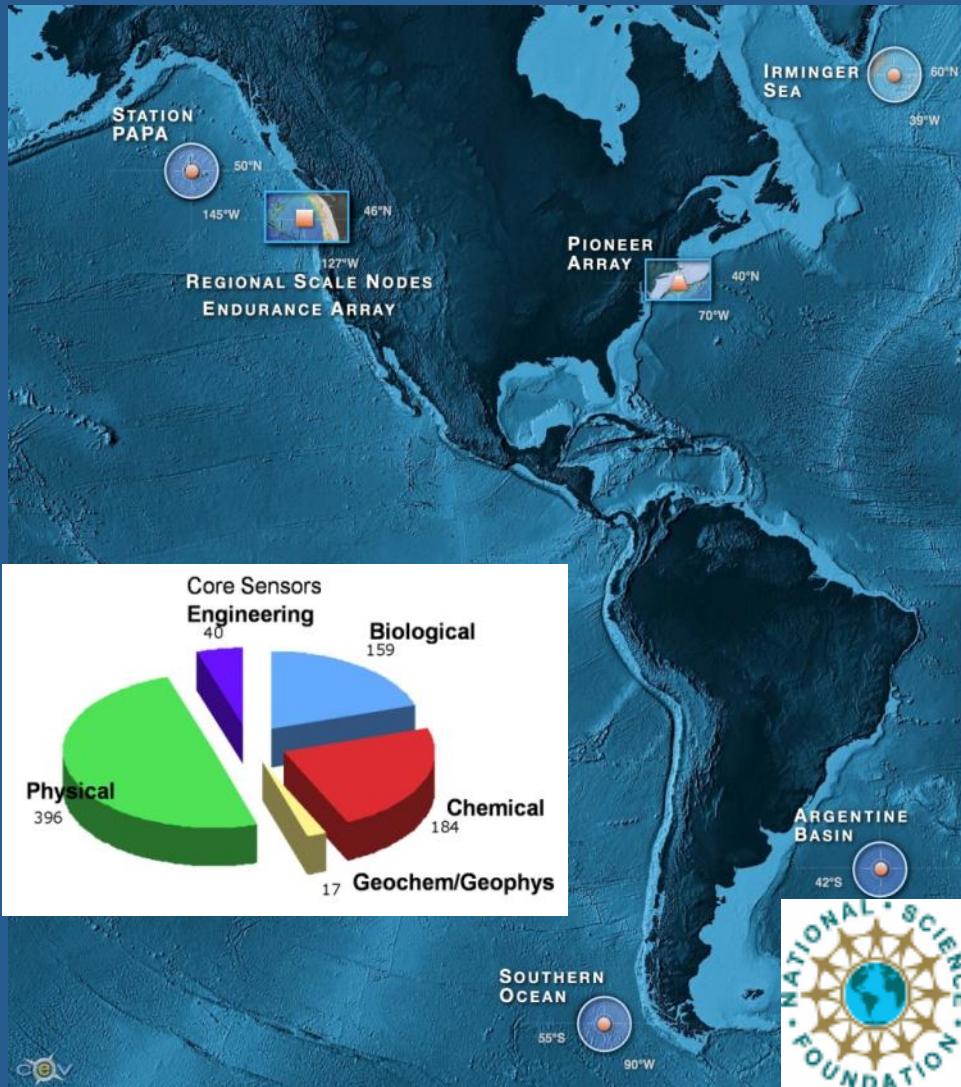
Graduate and Undergraduate students are integrated – good for IOOS now and good for industry for future employees



***Basic Observational Buoy (BOB)***  
Educational project for universities and high schools to address STEM disciplines

*U.S. Integrated Ocean Observing System (IOOS)*

# OOI – Research and Development Component



2022

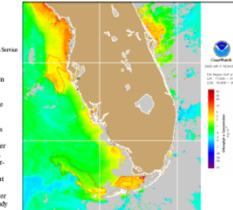


**NOAA Operational Forecast System**  
Gulf of Mexico, Demonstration since Sep 1999;  
Operational since Sep 2004:

An Operational forecast of impact: 0-3 days  
and a prediction of likelihood of a bloom for mgmt



Gulf of Mexico Harmful Algal Bloom Bulletin  
6 January 2005  
National Centers for Environmental Prediction, Data, and Information Service  
Lee County, Florida



Chlorophyll concentration from satellite with possible HAB areas shown by red polygons and arrows. Last updated on 01 Jan 2005 at 00Z. The following areas are indicated: Pinellas to northern Lee County, Patchy very low to high impacts possible.

Harmful Algal Bloom Forecasting System  
action on HAB detection and forecasting in the Gulf of Mexico

uses the options for  
provided by NOAA supplies  
development or movement of

observations, and buoy data

Conditions Report  
Monday, July 11, 2005  
A harmful algal bloom has been identified from northern Pinellas to northern Lee County. Patchy very low to high impacts possible in Pinellas and northern Sarasota Counties every afternoon through Thursday. Patchy very low to moderate impacts are possible in southern



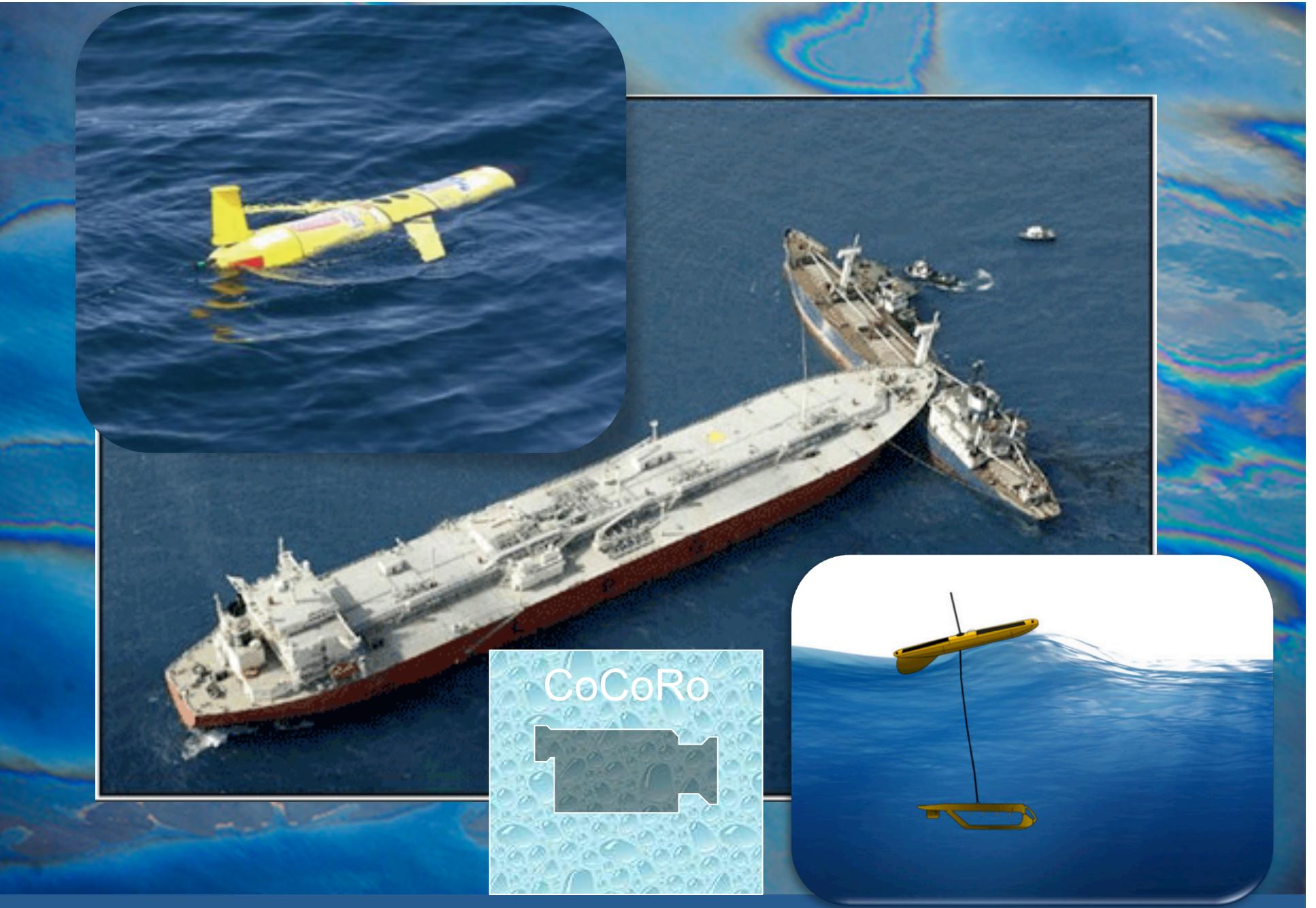
Modeling Workshop

1

Nov 2006

**Goal is to help other U.S. HAB areas**

<http://www.csc.noaa.gov/crs/habf>



- *Improving hazard responses*

# 2022

January							February							March						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
						1		1	2	3	4	5			1	2	3	4	5	
2	3	4	5	6	7	8	6	7	8	9	10	11	12	6	7	8	9	10	11	12
9	10	11	12	13	14	15	13	14	15	16	17	18	19	13	14	15	16	17	18	19
16	17	18	19	20	21	22	20	21	22	23	24	25	26	20	21	22	23	24	25	26
23	24	25	26	27	28	29	27	28						27	28	29	30	31		
30	31																			

April							May							June						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
						1	2	1	2	3	4	5	6	7		1	2	3	4	
3	4	5	6	7	8	9	8	9	10	11	12	13	14	5	6	7	8	9	10	11
10	11	12	13	14	15	16	15	16	17	18	19	20	21	12	13	14	15	16	17	18
17	18	19	20	21	22	23	22	23	24	25	26	27	28	19	20	21	22	23	24	25
24	25	26	27	28	29	30	29	30	31					26	27	28	29	30		

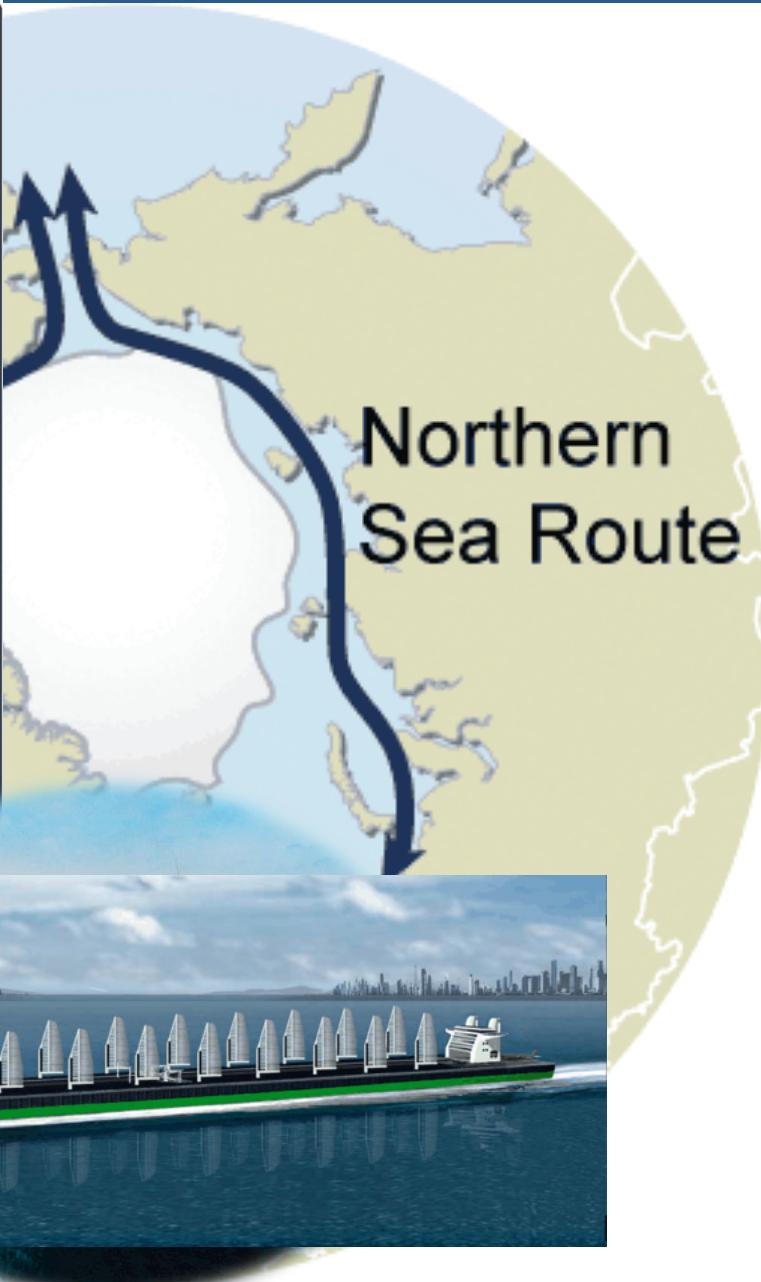
  

July							August							September						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
						1	2	1	2	3	4	5	6		1	2	3	4		
3	4	5	6	7	8	9	7	8	9	10	11	12	13	4	5	6	7	8	9	10
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31																				

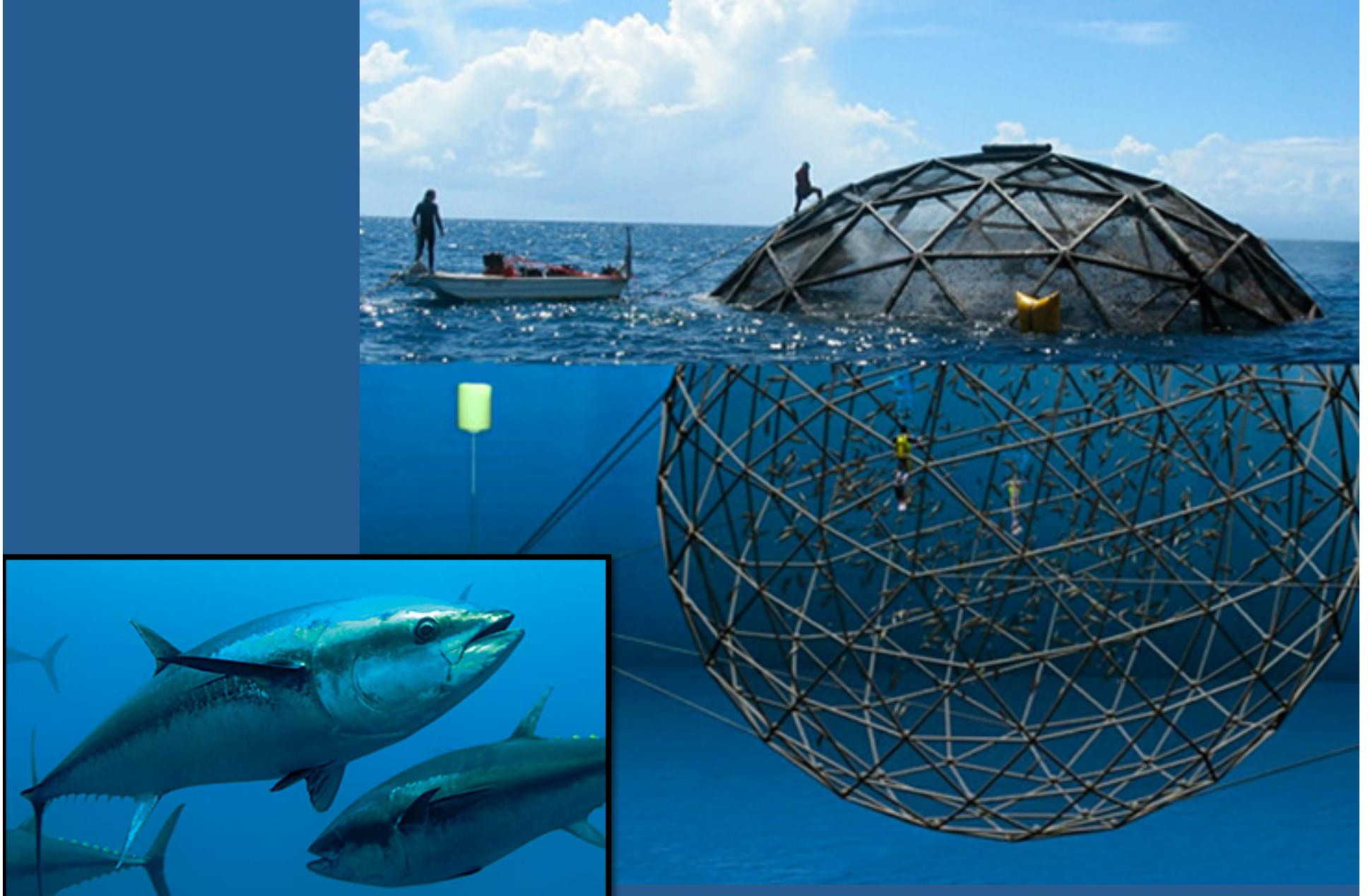
  

October							November							December						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
						1		1	2	3	4									
2	3	4	5	6	7	8	6	7	8	9	10	11								
9	10	11	12	13	14	15	13	14	15	16	17	18								
16	17	18	19	20	21	22	20	21	22	23	24	25	26	18	19	20	21	22	23	24
23	24	25	26	27	28	29	27	28	29	30				25	26	27	28	29	30	
30	31																			

HTTP://WWW.PRINTERFACIL.COM



- Improving the global economy



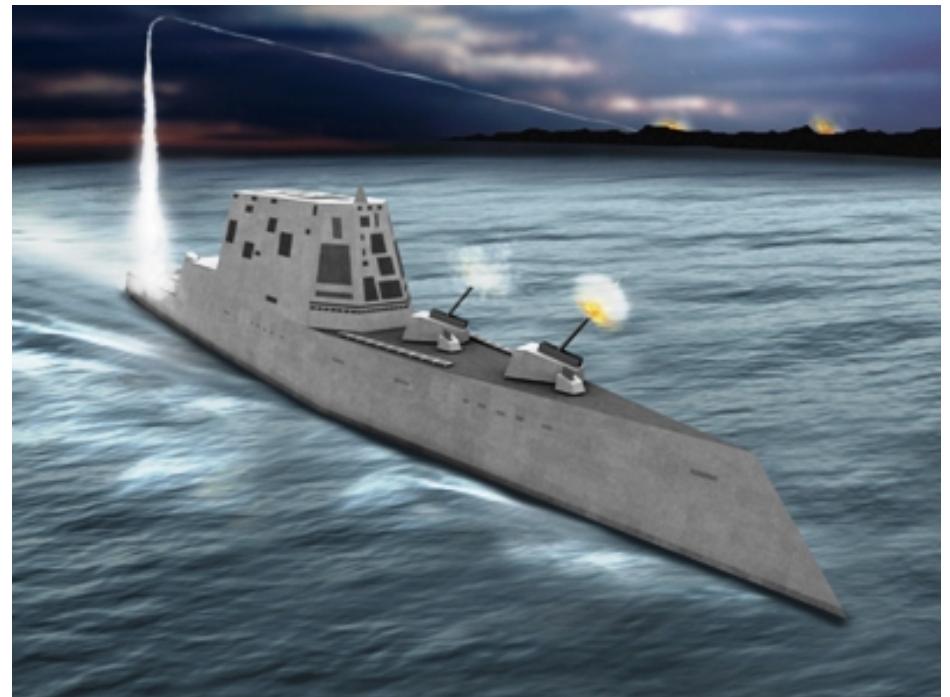
- *Improving fisheries management*

*This ... Strategic Direction implies a priority shift ... to maintaining capabilities which the United States has maintained technological superiority, e.g. survivable maritime and aviation platforms, dominant intelligence, surveillance and reconnaissance (ISR) ... ”*

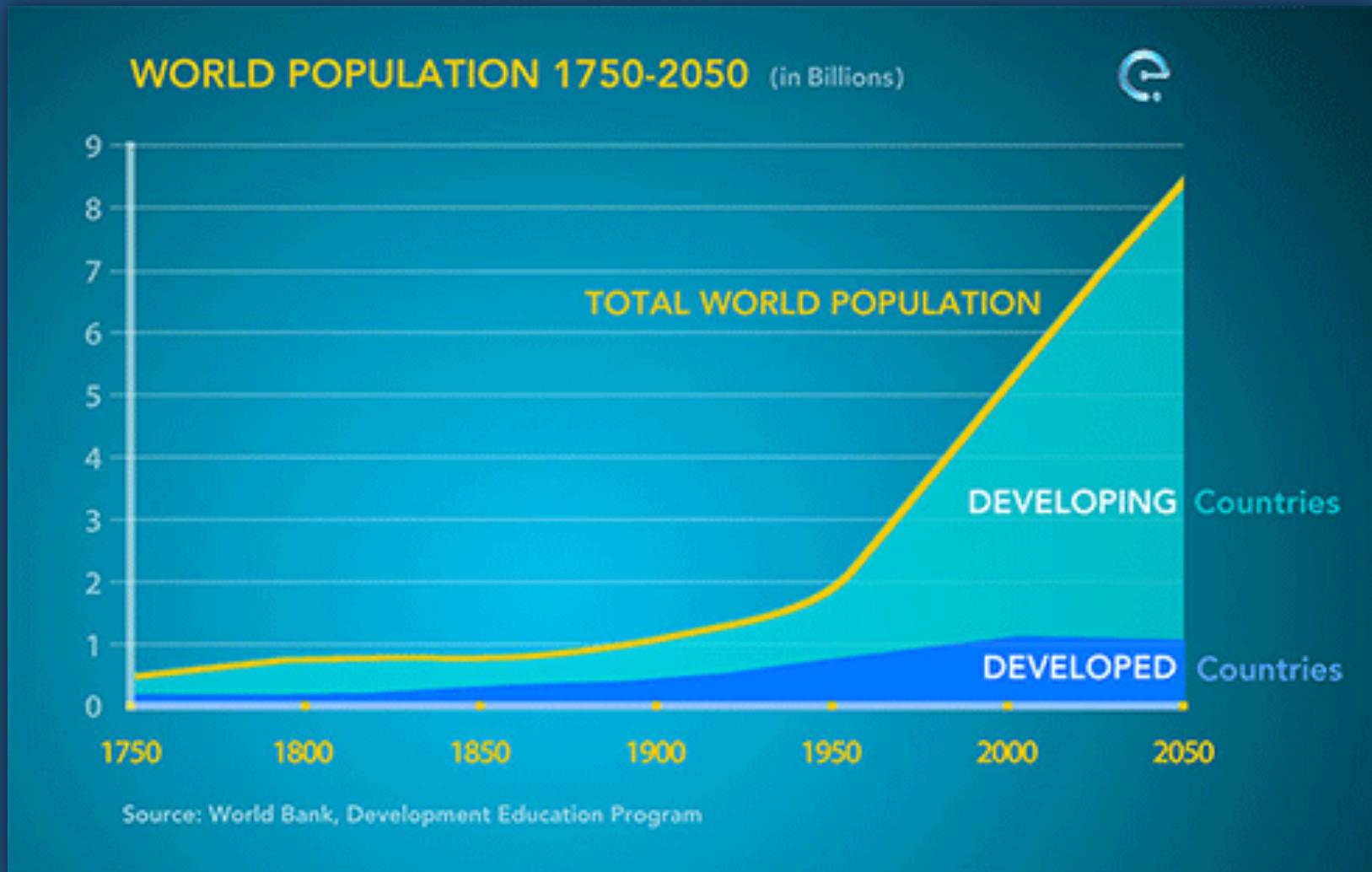
*“The United States cannot predict when or where aggression against an ally or a nation of interest could occur. It cannot station forces everywhere, so it must be prepared to wage war anywhere with limited warning.”*

## A Strategy-Based Framework for Accommodating Reductions in the Defense Budget

RAND  
National Defense Research Institute,  
October 2012



## *Driver: People and Culture*



Coastal communities around the world are **growing**.

## *Driver: Commerce and Economy*

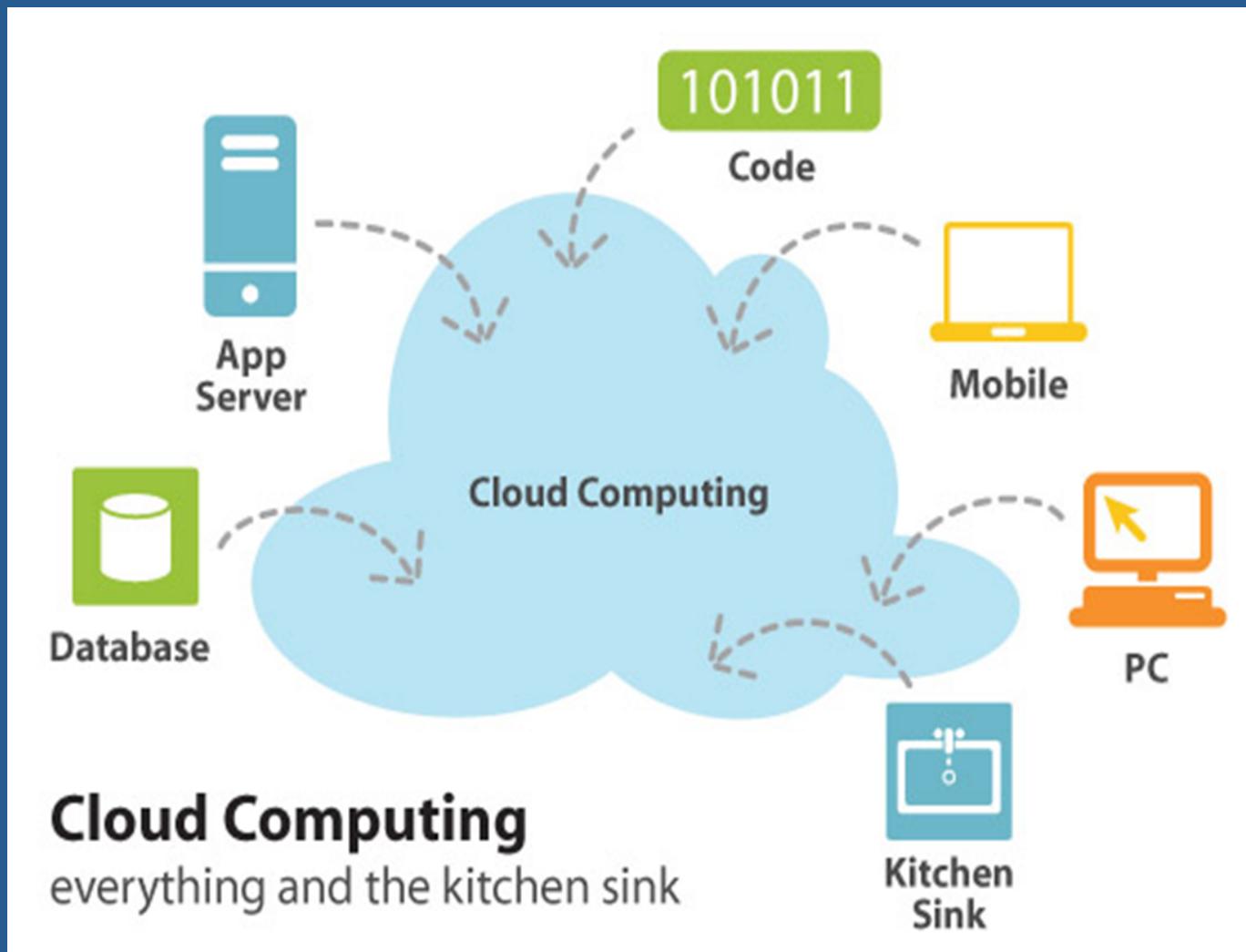


**99% by volume and 62% by value of U.S. foreign trade enters or leaves by ship.**



New sectors are investing in ocean resources and will need ocean data.

# *Driver: Technology and Communications*



Cloud computing is the new normal.

# *Drivers and Influencers: Politics, Policy and Governance*

National  
Ocean  
Council

Debt

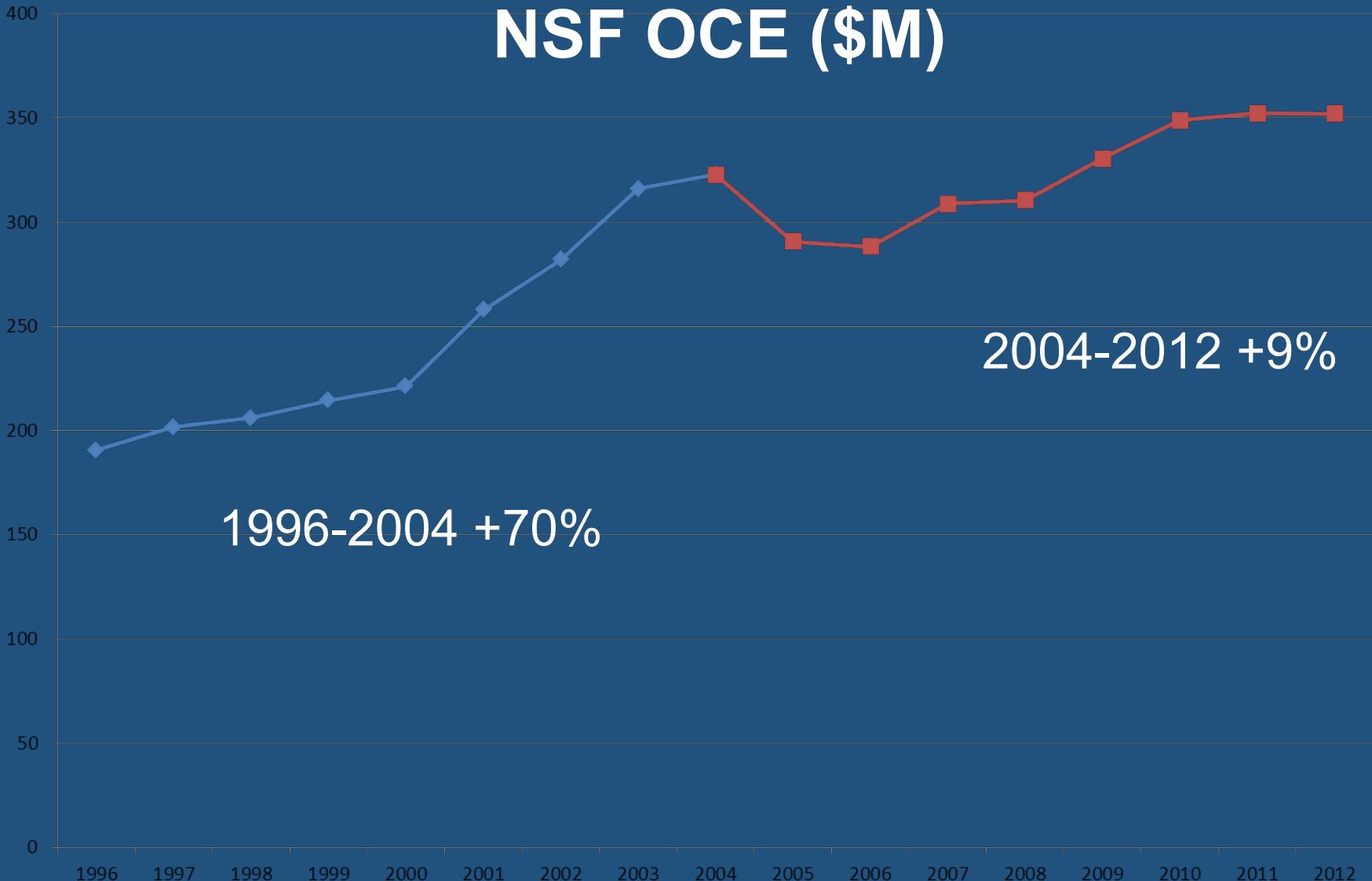
*"It is now obvious that enhanced and integrated observing systems are a key element underlying a robust ocean and climate science strategy." – Admiral James D. Watkins*

Seque-  
stration

New Ocean  
Legislation

*Driver: Public research funding*

## NSF OCE (\$M)



# Trends to watch

Federal funding – “Flat is the new doubling”

Technology – Moving from R&D to T&E (and thinking more about disruptive)

- Infrastructure – Ships, satellites and *in situ* observing systems can erode the science budgets

Business models – ROI, Angels, Equity

# *The Challenge for ocean observing R&D and operations*

## **Operationally reliable**

*Deliver accurate data consistently*

## **Financially sustainable**

*Diversify funding and increase leveraging*

## **Politically defensible**

*Prepare consistent answers about value*

## **Technologically extensible and evolvable**

*Flex to include new data sources*

## *The Vision*

The ocean observation services that are provided will be “full spectrum.”

*The enterprise of services dependent on ocean information will demand that the full array of relevant observations be operationalized.*

– *Draft IOOS Summit Report*

## *The Vision*



**Independent  
Cost Estimate**  
**\$3.6B per  
year...**  
**~ 3:1 ROI**



Public Value

# *The Vision*

The ocean observing system will promote the establishment of new models for workforce development.



## *The Vision*

The ocean observing enterprise will be expressed through a new system of governance.

*A wholly different concept will have to emerge, including ...*

- ✓ Public/private partnerships
- ✓ Cooperative R&D Agreements
- ✓ Gov't Owned / Contractor Operated principles
- ✓ Indefinite Delivery / Indefinite Quantity tools
- ✓ Legalized commingling of resources

## *Conclusion*

*Ultimately, we foresee a capability utilizing and delivering **products** from ocean observations that are fully **integrated** into the culture of our society, and is considered a non-negotiable component of our ability to enhance the **lives**, **livelihoods** and **quality of life** of future generations.*

**Products / Integrated / Lives / Livelihoods / Quality of Life**

# How *NOT* to use PowerPoint

- 1.Don't make lists
- 2.Don't use ONLY text
- 3.Don't use too much  
text

- IOOS SUMMIT 2012 DECLARATION

*In the United States, critical decisions affecting our lives, livelihoods and quality of life depend on successful communication and understanding of accurate and reliable scientific information about our oceans, coasts and Great Lakes. The U.S. Integrated Ocean Observing System (IOOS®) is a coordinated national, international, regional and local network of observations, modeling, data management and communications that provides the knowledge needed by society to protect life and property, to sustain a growing economic vitality, to safeguard ecosystems, and to advance quality of life for all people. Building upon progress over the past several decades, we must continue to expand, improve, and sustain the system to address the growing societal needs for ocean observations and information.*

## UNDERSTANDING OF THE NEED FOR IOOS

- Recent events underscore the importance of IOOS to the economic, security and environmental interests of the United States.
- Ocean, coastal and Great Lakes observations have proven to be essential for responding to weather, ocean, and human-mediated disasters on global, regional and local scales; as well as in reducing and mitigating the economic, social, and cultural risks of extreme events.
- The increasingly clear understanding of the scope and impacts of environmental changes, including sea level rise, the increase in ocean acidity, and the need to respond, adapt to and manage those changes, calls for a more extensive and sustained monitoring of the oceans and coasts as critical to understanding and predicting the earth's climate systems.
- Challenges of maintaining the quality and quantity of food and water for the US population and a rapidly growing global population will require improvements in our ability to predict ocean state conditions, weather, climate and extreme events including drought, harmful algal blooms and other conditions.
- Economic development and job growth in areas experiencing dynamic change, such as the energy sector and maritime transportation, accentuate the need for the public and private sectors in the United States to understand ocean and coastal conditions as they relate to a transforming global economy, and to ensure safe and efficient operations.
- A new dynamic of national and homeland security emphasizes that we must enhance our ability to monitor the oceans.
- The increasing need for sustained marine ecosystem goods and services requires a robust infrastructure for biological, biogeochemical and ecological observations.
- Ocean, coastal and Great Lakes observing leads to the creation of new high quality jobs to provide information supporting improved decision making in industries that depend on the oceans.

## MOVING FORWARD - THE NEXT TEN YEARS

### •OBSERVING CAPABILITY

- All IOOS components currently under-observe their target phenomena... deep-ocean observations, nearshore and estuarine observations, biological and chemical variables, ecosystem variables...remote sensing...build on the successes of the coordinated global ocean, terrestrial, atmospheric observing systems.

### •TECHNOLOGY AND WORKFORCE

- leading edge technology development capabilities... emerging technologies as a standard operating procedure, in particular leveraging the development of the Ocean Observatories Initiative...a workforce for the future, adept at developing, using and furthering these technologies.

### •MODELING AND PREDICTIVE CAPABILITY

- Improved and more sophisticated models

### •INFORMATION PRODUCTS

- quality-controlled data and information products that support critical decision making for multiple uses. ...critical role in ocean literacy and education at all levels.

### •PARTNERSHIPS

- federal and state government agencies, tribes, regional partnerships, the academic community, and the private commercial and environmental communities. ..will help to sustain global efforts, as well as derive understanding and context from parallel efforts around the globe.

### •USER COMMUNITIES

- ...support an increasingly diverse user community.

### •RESOURCES

- Federal support has been and will continue to be critical to the success of IOOS.... a broadening of funding support, additional funding sources, and innovative public-private partnerships.

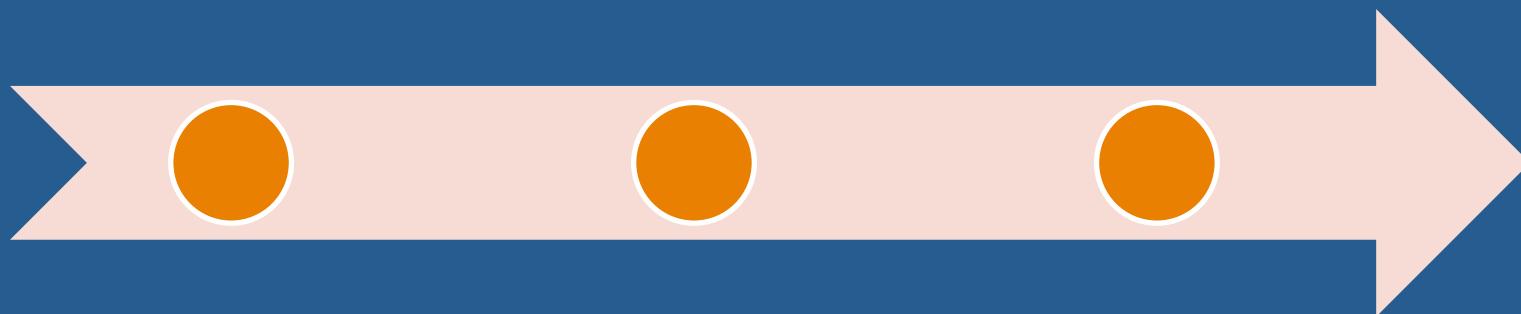
# On to the future ...

2000-2010

Demonstrated  
**commitment**  
to ocean  
observations

2012-2022

Expected  
**value** of  
ocean  
observations



2010-2012

Requested  
**accountability**  
from ocean  
observations

# THANKS!